

What is claimed is:

1. A catalytically active composition comprising a polystyrene copolymer, the polystyrene copolymer comprising a first styrene monomer and a second styrene monomer, wherein the first styrene monomer is substituted with one or more catalytically active functional groups and the second styrene monomer is substituted with one or more lipophilic groups.
2. The composition of claim 1, wherein the first styrene monomer is substituted with a triorganophosphine.
3. The composition of claim 1, wherein the first styrene monomer is substituted with a triarylphosphine.
4. The composition of claim 1, wherein the first styrene monomer is substituted with a nucleophilic organic catalyst.
5. The composition of claim 1, wherein the first styrene monomer is substituted with a catalyst selected from the group consisting of imidazoles, thiazoles, pyridines, and (4-pyridyl)piperazine).
6. The composition of claim 1, wherein the first styrene monomer is substituted with 4-pyridylpiperazine.
7. The composition of claim 1, wherein the first styrene monomer is substituted with a metal complex.
8. The composition of claim 1, wherein the first styrene monomer is substituted with a metal complex selected from the group consisting of 3,5-*bis*(phenylthiomethyl)phenyl palladium chloride and diadamantylphosphine palladium.

9. The composition of claim 1, wherein the second styrene monomer is substituted with a functional group selected from the group consisting of hydrocarbons, hydrocarbons substituted with one or more ester groups, hydrocarbons containing one or more ether groups, and hydrocarbons containing one or more amine groups, amides and triorganosilyl ethers.

10. The composition of claim 1, wherein the second styrene monomer is *tert*-butylstyrene.

11. The composition of claim 1, wherein the polystyrene copolymer further comprises styrene monomers substituted with one or more dye species.

12. A method of catalyzing a chemical reaction, the method comprising:

providing one or more substrates and a catalyst in a latent biphasic solvent that is switchable between a monophasic state and biphasic state, the biphasic state comprising a more polar phase and a less polar phase, wherein the products of the catalytic reaction are preferentially soluble in the more polar phase and the catalyst is preferentially soluble in the less polar phase;

allowing the catalytic reaction to proceed while the latent biphasic solvent is monophasic;

inducing the latent biphasic solvent to become biphasic; and

separating the more polar phase from the less polar phase;

wherein the catalyst comprises a polystyrene copolymer, the polystyrene copolymer comprising a first styrene monomer and a second styrene monomer, wherein the first styrene monomer is substituted with one or more catalytically active functional groups and the second styrene monomer is substituted with one or more lipophilic groups.

13. The method of claim 12, wherein the second styrene monomer is substituted with a functional group selected from the group consisting of hydrocarbons, hydrocarbons substituted with one or more ester groups, hydrocarbons containing one or more ether

groups, and hydrocarbons containing one or more amine groups, amides and triorganosilyl ethers.

14. The method of claim 12, wherein the second styrene monomer is *tert*-butylstyrene.

15. The method of claim 12, wherein the latent biphasic solvent comprises one or more solvents selected from the group consisting of alkanes having five to twelve carbon atoms, *N,N*-dimethylacetamide, alcohols having two to four carbon atoms, ethers having four to eight carbon atoms, toluene, and mixtures thereof.

16. The method of claim 12, wherein the latent biphasic solvent comprises heptane and ethanol.

17. The method of claim 12, wherein the latent biphasic solvent comprises about heptane, ethanol, and water, wherein the monophasic state has a heptane:ethanol:water ratio of about 10.0:9.5:0.5 (vol:vol:vol) and wherein the diphasic state has a heptane:ethanol:water ratio of about 10.0:9.5:1.0 (vol:vol:vol).

18. The method of claim 12, wherein the latent biphasic solvent comprises toluene, ethanol, and water.

19. The method of claim 12, wherein the latent biphasic solvent comprises *N,N*-dimethylacetamide and heptane.

20. The method of claim 12, wherein the inducing step comprises cooling the latent biphasic solvent.

21. The method of claim 12, wherein the inducing step comprises adding water to the latent biphasic solvent.

22. The method of claim 12, wherein the inducing step comprises adding salt to the latent biphasic solvent.

23. A catalytic composition comprising a catalytically active functional group bound to polyisobutylene.

24. The composition of claim 23, wherein the catalytically active functional group comprises a triorganophosphine ligand.

25. The composition of claim 23, wherein the catalytically active functional group comprises an alkyl diaryl phosphine ligand.

26. The composition of claim 23, wherein the catalytically active functional group comprises a triorganophosphine ligand complexed with palladium.

27. A method of catalyzing a chemical reaction, the method comprising:

providing one or more substrates and a catalyst in a latent biphasic solvent that is switchable between a monophasic state and biphasic state, the biphasic state comprising a more polar phase and a less polar phase, wherein the products of the catalytic reaction are preferentially soluble in the more polar phase and the catalyst is preferentially soluble in the less polar phase;

allowing the catalytic reaction to proceed while the latent biphasic solvent is monophasic;

inducing the latent biphasic solvent to become biphasic; and

separating the more polar phase from the less polar phase;

wherein the catalyst comprises catalytically active functional group bound to polyisobutylene.

28. The method of claim 27, wherein the catalytically active functional group comprises a triorganophosphine ligand.

29. The composition of claim 27, wherein the catalytically active functional group comprises an alkyl diarylphosphine ligand.
30. The composition of claim 27, wherein the catalytically active functional group comprises a triorganophosphine ligand complexed with palladium.
31. The method of claim 27, wherein the latent biphasic solvent comprises one or more solvents selected from the group consisting of alkanes having five to twelve carbon atoms, *N,N*-dimethylacetamide, alcohols having two to four carbon atoms, ethers having four to eight carbon atoms, toluene, and mixtures thereof.
32. The method of claim 27, wherein the latent biphasic solvent comprises heptane and ethanol.
33. The method of claim 27, wherein the latent biphasic solvent comprises about heptane, ethanol, and water, wherein the monophasic state has a heptane:ethanol:water ratio of about 10.0:9.5:0.5 (vol:vol:vol) and wherein the diphasic state has a heptane:ethanol:water ratio of about 10.0:9.5:1.0 (vol:vol:vol).
34. The method of claim 27, wherein the latent biphasic solvent comprises toluene, ethanol, and water.
35. The method of claim 27, wherein the latent biphasic solvent comprises *N,N*-dimethylacetamide and heptane.
36. The method of claim 27, wherein the inducing step comprises cooling the latent biphasic solvent.
37. The method of claim 27, wherein the inducing step comprises adding water to the latent biphasic solvent.

38. The method of claim 27, wherein the inducing step comprises adding salt to the latent biphasic solvent.